1948

NEW ZEALAND

DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH

(TWENTY-SECOND ANNUAL REPORT OF THE)

Presented to both Houses of the General Assembly by Leave

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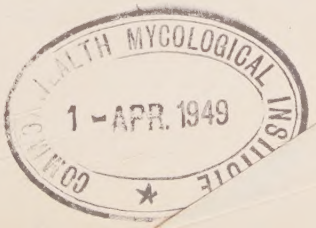

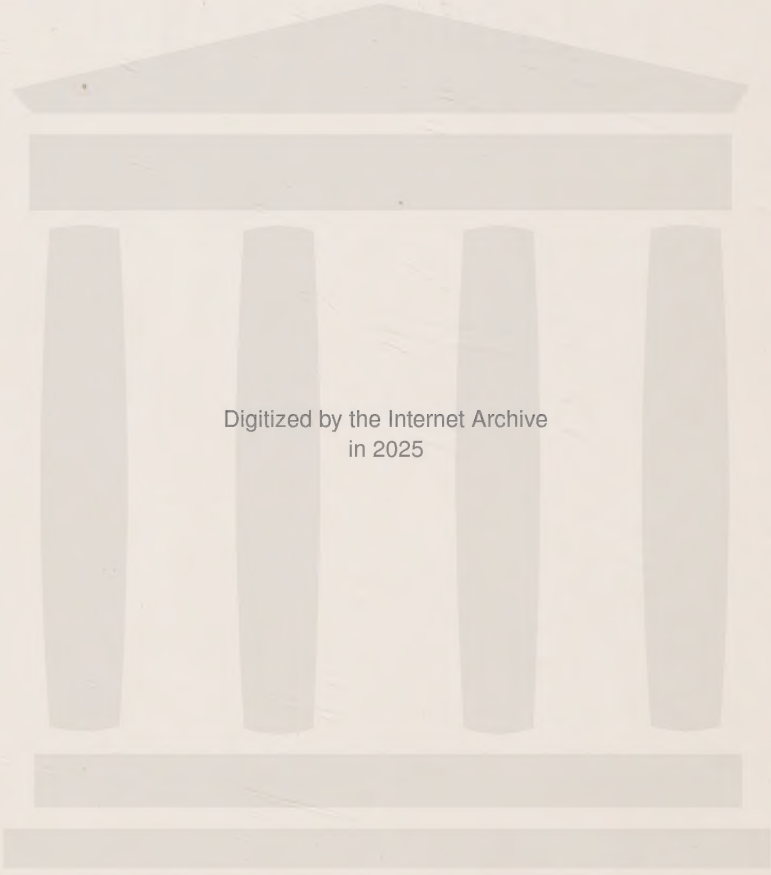

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MINISTER'S STATEMENT

The year has seen an intensification of work in all branches of the Department. Increasing assistance in an extremely wide range of problems has been sought by farmers, industrialists, and State Departments. This is but a natural development in view of the extent to which science is entering into every phase of life and industry, and in view of the increasing recognition of the part which research is capable of playing in all aspects of the national welfare and progress. The Department has experienced difficulties in meeting the demand on account of limitation in the number of qualified scientists available and through lack of suitable accommodation, problems which, however, will ultimately be overcome. Anxiety to provide assistance as widely as possible has therefore led to the extension of scientific man-power resources to their uttermost limit, with the result that progress in dealing with some problems has not been as rapid as it would have otherwise been. Nevertheless, the record of achievement in all branches of research activity has been good, and sound progress has been made.

In view of the importance of the world food shortage, research fundamental to the development of the farming industries has been activity pursued. Regional soil surveys have been completed over extensive areas in the South Island and more intensive surveys undertaken for special purposes in portions of the North Island. This work also has been related closely both to soil-conservation and land-utilization problems requiring almost immediate attention. It has been found possible to extend pasture research to hill-country areas and to intensify this work on flat country towards securing higher returns from our grassland resources. Distinct progress has been made in pasture-management research and in the understanding of the nutrition requirements of ordinary pastures. The results of this work when applied in farm practice give promise to enabling still higher yields to be secured from grasslands. In the sphere of arable farm crops, selection and breeding work is proceeding which enables improved strains to be developed and the maintenance of a high-quality standard of seed. The new wheat variety, "Hilgendorf," has provided the Dominion with a grain of exceptionally high protein quality with no loss of yield. A comprehensive study of frost damage has been inaugurated in fruit and horticultural crop areas with a view both to bringing about improvements in frost forecasting and to devising better methods of reducing injury to crops.

Soil and manurial investigations are helping materially in the extension of the tobacco crop and improving its yield. Pioneer work in methods of kiln curing has indicated that distinct improvements are in prospect. Chemical studies of tobacco leaf correlated with quality tests are throwing much useful light on the complex question of smoking quality of New-Zealand-grown tobacco. Research for the hop industry was commenced during the year and a survey of the growing and curing problems of the industry has been made. The resourcefulness shown by tobacco and hop growers in promoting research in their respective industries is to be highly commended and is likely to place these industries on an increasingly sound basis. In the phormium industry, while no new results can be reported upon yellow-leaf disease, which is now the subject of intensified research, much useful new knowledge has been gained on the propagation and management of phormium areas. Unfortunately, through lack of continued study of this valuable native fibre plant in past years, there is a great dearth of sound information now available.

A thorough investigation of new European processes of manufacturing butterfat, in which churning is dispensed with, is being undertaken by the Dairy Research Institute in collaboration with the Department of Agriculture and the New Zealand Co-operative Dairy Co. Fundamental research on the nature of butterfat and changes in its composition during various seasons of the year is yielding much information of real value to the industry.

The year has been one of marked advance in research developments relating to the manufacturing industries which have brought many new problems to the Dominion Physical Laboratory, the Dominion Laboratory and its branches, and the Auckland Industrial Development Laboratories. Negotiations have been almost completed for the establishment, under the jurisdiction of Canterbury University College, of the Canterbury College Industrial Development Department, which will provide service, development, and research for South Island manufacturers. These branches of the Department, working in close association with industry, will enable a high standard of quality to be maintained in locally made products, and ensure that these industries have highly qualified personnel and well-equipped centres to which their particular problems may be referred. All the research associations connected with the manufacturing industries have been very active. Tanners and footwear-manufacturers have combined during the year in the formation of a Leather and Footwear Manufacturers' Research Association, and negotiations are still proceeding for the establishment of a Laundry Research Association. The active interest and participation of New Zealand industrialists in the formation and development of research activities and the application of science to their regular problems is most encouraging.

The Department has engaged in a great deal of service and research work for other State Departments and public bodies. Coal surveys, research on the utilization of high-sulphur coals, and economies in the use of coal in boiler furnaces have been dealt with by the Dominion Laboratory and the Geological Survey, whose officers have also conjointly pursued investigations on the quantity and quality of the Dominion's resources of clay minerals, glass-sands, and iron-sands. Extensive geophysical surveys have been carried out for the State Hydro-electric Department in connection with foundation studies necessary for the construction of dams on the Waikato River. Model studies of water flow associated with each proposed dam have also been undertaken to guide the design work necessary on the actual sites. Problems associated with foundations for large buildings, factories, mills, earth dams, and tanks have been a prominent feature of the soil physics section of the Soil Bureau. The magnetic survey of the Dominion has been extended and re-examined at more frequent intervals, further seismographs have been installed for the study of earthquakes and earth movements, and regular observations of the ionosphere continued to assist in radio problems. The installation of radar in coastal shipping has been assisted by the staff of the Dominion Physical Laboratory.

During the year special attention has been devoted to the relation of science to the building industry. The visit of Sir Reginald Stradling, a world authority in this sphere, at the invitation of the Government has been most valuable, and his comprehensive report provides a sound basis for future development in this direction.

An increased eagerness to be kept informed of all research development is a characteristic of the times. Both the tempo of research progress and its application has markedly increased. There is also a very real need to keep the public abreast of all research advances so that steps are taken to make the many social and economic adjustments that are requisite with the march of progress. The Information Bureau has strengthened these aspects of its activities, bearing in mind the important implications of the need for disseminating only sound and proved conclusions.

The Commonwealth and international aspects of science and research have increased in importance in recent years, and this has been met by the maintenance of scientific liaison staff overseas, by making provision for the staffs of various branches to attend overseas scientific conferences and to engage in special courses of study in order to keep up to date in their knowledge.

The Department has continued to bring to every branch of industry and State activity that assistance which the wide ramifications of science to-day makes available, in the belief that in the proper utilization of this new knowledge lies the soundest means of assuring promotion of the national welfare.

T. H. McCombs,
Minister in Charge of the
Scientific and Industrial Research Department.

SECRETARY'S REPORT

The Hon. T. H. McCombs, Minister in Charge of the Department of Scientific and Industrial Research.

I have the honour to submit herewith the annual report of the Department for the year 1947–48.

The year just completed has seen an expansion of the Department's activities in order to meet a marked increase in the immediate demands for scientific assistance which has arisen in every State Department and industry in this phase of the post-war period. Moreover, a policy of endeavouring to anticipate the scientific needs of the next decade has been adopted in all branches where opportunities have permitted it. In view of the momentous progress which is taking place overseas in physical, biological, and chemical sciences, the Department has not been unmindful of its responsibility to keep abreast of these developments and to be aware of their significance in so far as they may affect the welfare of the Dominion. Accordingly, arrangements have been made for a number of officers to undertake courses of studies in overseas institutions and to attend scientific conferences abroad. Through these means, through scientific liaison officers overseas, and through the provision of local facilities to enable work in the newer scientific developments to be done here, definite steps are being taken to ensure that the knowledge and benefits of scientific advances made in other countries are brought to New Zealand.

The extent to which State Departments and industrialists are referring their problems to the Department has been the cause of some embarrassment owing to the difficulties still being experienced in regard to shortages of qualified staff and accommodation. These difficulties have caused delays in the completion of problems on which advice was sought, with consequent disappointment. Again it has been found that sudden demands for extensive assistance have arisen where some promising results have emerged from scientific explorations done on a modest scale. The staff situation at present has unfortunately prevented such demands being adequately met. The shortage of experienced and qualified staff is a very real handicap, but perhaps even more serious for some branches of the Department is the now totally inadequate buildings in which they are housed. The efficiency and output of work from such branches could be greatly improved if they were provided with adequate accommodation. Furthermore, the time is rapidly approaching when the Department will be unable to undertake some important national tasks unless additional and better accommodation is provided.

There has been an increase in collaboration between various branches of the Department and with other State Departments in dealing with problems which require approaches from a number of different angles. This has enabled progress to be made and has lessened, to some extent, the handicaps imposed by shortage of staff and accommodation.

The Head Office organization of the Department has been strengthened in order to meet the administrative needs of the extending activities of its research branches.

A Hop Research Association was, at the request of hop-growers and brewers, established during the year, funds for the research work proposed being provided by the industry and the State in equal amounts.

Tanners and footwear-manufacturers have combined their resources for the formation of a Leather and Footwear Research Association, which will extend the scope of the existing Leather Research Association.

Geophysical investigations associated with the examination of dam-sites for hydro-electric power-stations and for coal surveys have been actively pursued, and this work will be extended now that staff and equipment from overseas seem more likely to be available.

The Plant Chemistry Laboratory and the Dominion Laboratory have installed a plant for the preparation of antibiotic substances, and small quantities of penicillin have already been made.

The Geological Survey has continued its field-work in connection with surveys of coal, clays, and sands. The Dominion Laboratory has had the examination of high-sulphur coals carefully carried out with a view to devising methods for reduction or elimination of their sulphur content. Similarly, a thorough examination of New Zealand's clay and sand resources, which have distinct industrial possibilities, is being undertaken conjointly by the Geological Survey, Dominion Laboratory, and the Ceramic Research Association.

Frost-fighting investigations in Central Otago and Auckland have been a combined effort on the part of the Plant Diseases Division, Meteorological Office, Auckland Industrial Development Laboratories, and Dominion Physical Laboratory. The initial year's work has provided some very useful data which will be helpful for future investigations.

Phormium research has been intensified during the year under the leadership of the Botany Division, special attention being devoted to measures to overcome yellow-leaf disease and to propagation and management studies.

The fruit research activities of the Department have been reorganized and consolidated into a branch under a Director. Special attention has been devoted to research problems affecting building and civil engineering, concerning which Sir Reginald Stradling paid a visit to New Zealand at the invitation of the Government and furnished a valuable report on his observations. This report will provide a sound basis for future developments.

The visit of Sir Ben Lockspeiser enabled an assessment to be made of the Dominion's possibilities and responsibilities in connection with aeronautical research.

The Canterbury Project, an investigation on anomalous radar propagation carried out conjointly by the United Kingdom and New Zealand Governments at Ashburton, concluded its field-work after a very successful season. The mass of data accumulated during the 1947 season is now being worked up.

Defence science matters have been reviewed extensively during the year, and an organization established for providing effective liaison with the Services.

The Research Council has met on seven occasions during the year, and the Department is indebted to it for its active interest in all research activities and developments and for the advice and guidance received from it. Its personnel was as follows :—

T. Rigg, K.B.E., M.A., M.Sc., F.R.I.C., F.R.S.N.Z., Chairman. J. C. Andrews, Ph.D., M.Sc. T. G. G. Beck, A.M.I.C.E. N. L. Edson, B.Med.Sc., M.B., Ch.B., Ph.D. (Cantab.). R. O. Page, D.Sc. J. M. Ranstead, Esquire. W. Riddet, B.Sc. (Agric.), N.D.A., N.D.D. R. B. Tennent, N.D.D. D. F. Sandys Wunsch, M.A. (Oxon.), B.Sc. (McGill), M.I.Chem.E., Assoc. Inst.M.M. E. Marsden, C.M.G., C.B.E., M.C., D.Sc., F.R.Sc., F.R.S.N.Z., Secretary. F. R. Callaghan, M.A., F.R.E.S., Deputy Secretary.

Council sustained a severe loss during the year through the death of Mr. T. G. G. Beck. His death was most regrettable, in that the Council lost thereby the assistance of an outstanding engineer of wide experience, sound judgment, and extensive interests.

On the 20th September, 1947, Dr. Marsden left New Zealand to take up an appointment as Scientific Liaison Officer and New Zealand Government Scientific Adviser in London. Dr. Marsden had been Permanent Head of the Department since its establishment in 1926. His high eminence as a scientist, his foresight, inspiration, initiative, energy, ability, and personality, had been responsibile for the sound progress made by the Department during the first critical twenty-one years of its existence.

To foster closer association between the University, the Research Council, and the Department, a Liaison Committee was established to consider periodically matters of mutual interest.

Consideration has been given to nuclear physics investigations, including surveys for radio-active minerals and the use of isotopes in soil, plant, and animal studies.

It is pleasing to record the generous measure of collaboration accorded to the Department by other Departments of State, the New Zealand University and University colleges, and by Cawthron Institute in many spheres of activity during the year.

Expenditure

The net expenditure for the year amounted to £656,752. The following was the expenditure incurred in the various branches of the Department:—

	£
Permanent services—	
Head Office: Comprising general expenses of administration	32,807
Dominion Laboratory and branches	75,388
Dominion Observatory	4,667
Geological Survey	37,221
Magnetic Observatory	6,654
Dominion Physical Laboratory	169,584
Auckland Industrial Development Laboratories	18,218
Apia Observatory	4,691
Research investigations	275,117
Grants to University agricultural colleges, Cawthron Institute, and research associations	46,701
Grants made to research and allied institutions in Great Britain	10,350
Other grants, miscellaneous services, including Information Bureau and Scientific Liaison Services	63,607
	745,005
Recoveries	88,253
	£656,752

Personnel

The personnel of the Department and its disposal at 31st March, 1948, was as follows:—

Agronomy, Botany, Entomology, Grasslands, and Plant Diseases Divisions	142	Fats Research Laboratory	16
Auckland Industrial Development Laboratories	24	Geological Survey	48
Defence Development Section	30	Head Office (including Information Bureau) and district offices	131
Dominion Laboratory and district branches	115	Observatories: Apia, Magnetic, and Dominion	22
Dominion Physical Laboratory	175	Soil Bureau	62
		Miscellaneous	58

Total staff, including clerical officers, typists, technicians, and professional officers, 823 (474 permanent and 349 temporary). During the year there was arranged a large transfer of temporary officers to permanent status. The shortage of experienced research workers, high-grade technicians, and typing staffs has continued and has impaired the output of work in all branches of the Department.

I desire to express appreciation of the high standard of loyalty and service rendered by the staff in all branches of the Department. The fact that this service was given often in difficult circumstances of accommodation and shortages of qualified assistance renders the achievements more meritorious.

F. R. Callaghan, Secretary.

REPORTS OF RESEARCH COMMITTEES OF THE COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

AERONAUTICAL RESEARCH

The Government has established the New Zealand Aeronautical Research Committee, under the ægis of the Department, to co-ordinate aeronautical research in Government Departments and University Colleges, and to advise the Government on matters relating thereto.

The Aeronautical Committee's main activities during the year have been the selection of the scholar for the New Zealand Government scholarship award to the United Kingdom College of Aeronautics, and detailed consideration of what aeronautical research New Zealand might undertake as a contribution to the Commonwealth effort in this sphere.

The Committee was favoured with a visit from Sir Ben Lockspeiser, Chief Scientific Adviser of the United Kingdom Ministry of Supply, just prior to the despatch of the New Zealand delegation to the first meeting of the Commonwealth Advisory Aeronautical Research Council, held in Australia in April.

The Committee prepared a statement for presentation at the Commonwealth meeting which, in its main points, received the general approval of the Government. It is anticipated that arising from the Commonwealth meeting proposals will be submitted to Government for consideration during 1948 whereby New Zealand may be able to play a larger part than hitherto in Commonwealth aeronautical research.

BUILDING RESEARCH

During the year, at the invitation of the New Zealand Government, Sir Reginald Stradling visited the Dominion in order to report on the present position of building research and also to make recommendations as to its future organization. Sir Reginald made a very extensive tour of New Zealand, at the end of which he submitted a comprehensive and valuable report to the Government. This report has received detailed consideration by officers of the various Departments interested, and recommendations have now been made to the Government. It is hoped that arising out of Sir Reginald Stradling's report the Department will in the future be able to press forward this work, which is of vital importance to one of the Dominion's largest industries.

Pending a decision on the future organization of building research within the Department, research work under the control of the Building Research Committee has continued in various sections of the Department and is reported below.

Dominion Physical Laboratory

Heat Insulation of Houses.—Measurements of thermal transmittance of walls, floors, and ceilings of houses in the field have been continued and measurements of several concrete houses made in Wellington and in Palmerston North, including two with transmittance values approaching the low value revealed in a traditional wooden house.

Measurements of the Efficiencies of Domestic Water-heaters.—Following a report published on the measurement of efficiencies of dairy water-heaters, requests were made by the New Zealand Standards Institute for similar measurements on domestic water-heaters with a view to obtaining the maximum thermal efficiency practicable.

Physical Properties of Pinus radiata *in Structural Sizes.*—At the request of the State Advances Corporation a programme has been prepared for the measurement of the mechanical strength and elasticity of *Pinus radiata* in certain structural sizes used in domestic buildings. The project has been planned by a joint committee representing the State Advances Corporation, Housing Construction Department, State Forest Service, and the Department of Scientific and Industrial Research.

Ventilation of Building Cavities.—A problem outstanding from the dampness and mould in houses investigation is the question of the minimum ventilation rate allowable in the cavities of the walls of dwellings to keep structural timbers free from dry rot. Long-term observations are now in progress to discover the rates of drying of green timber when subject to very low ventilation rates with atmospheres at controlled relative humidities.

Plant Diseases Division

Timber Preservation

Biological Evaluation of Toxicity of Preservatives.—(*a*) *Against Insects:* Toxicity tests against *Anobium punctatum* (common borer) were made with a number of chemicals and proprietary mixtures. Six have been recommended for use at prescribed strengths.

(*b*) *Against Fungi:* The first series of experimental flitches from the "graveyard" test plots was lifted and sticks measured for decay damage.

Treatment of Infested Buildings.—A technique which enables comparisons of insecticides applied to infested wood has now been evolved.

Preservative Treatment by Pressure.—Tests to measure effects of solution temperature on speed of absorption with several timbers have been completed. Sufficient information has now been secured on pressure treatment to form a basis upon which recommendations for commercial treatments can be made.

General.—During the year the Wood Technologist spent three months at the Division of Forest Products of the Council of Scientific and Industrial Research, Melbourne. The visit has already proved of excellent value in the New Zealand work.

Dominion Laboratory

Building-materials Section

Paint.—Exposure Tests on House Paints: A wide range of climatic conditions is now covered by the paint exposure fences. Practical results are commencing to come to hand.

Accelerated weathering tests have given valuable information and a second "weatherometer" is being obtained.

Cement-asbestos and Portland cement paints are undergoing tests.

Many routine analyses and tests of paints have been carried out mainly for the Housing Construction Department and the State Advances Corporation.

A small bi-monthly periodical, *Paint Review*, has been commenced to assist in the dissemination of information to the paint trade.

Building-materials.—Deterioration of Concrete: Concrete in a large irrigation dam was found to have been badly laid. A large amount of lime had been leached from the structure.

Experimental work has been commenced to investigate attack on concrete structures and underground pipes by aggressive waters.

The presence of sulphuretted hydrogen in a railway tunnel under construction was shown to be due to the presence of sulphate-reducing bacteria behind the concrete lining. Advice was given in the placing of new concrete rendered necessary in remedial work in the tunnel.

Concrete Roofing-tiles: Advice on colouring of tiles has enabled several manufacturers to improve their product.

Auckland University College

(Auckland Panel—Building Research Committee)

Pumice Concrete.—Further work on pumice concrete has been held over pending the construction of a suitable room and control equipment to ensure reliable results.

Testing Properties of Building-materials.—A number of commercial products were tested for Government Departments, principally pre-cast building blocks, slabs, &c.

THE DAIRY RESEARCH INSTITUTE (N.Z.)

Annual report now published separately by Dairy Research Institute (N.Z.), Incorporated, Palmerston North.

FRUIT COLD STORAGE RESEARCH

Refrigerated Gas Storage of Apples.—Cabinet-scale tests were continued on the Granny Smith variety. Fruit was held in various atmospheres at temperatures of 34° F., 36° F., and 38° F.

Results have not been conclusive, but suggest that optimum conditions for this variety may be found in a carbon-dioxide content higher than 6 per cent. with an oxygen content somewhere between 5 per cent. and 10 per cent., at a temperature of around 38° F. Under the conditions tested this season, the fruit had reached the end of its storage life before December.

A further trial was made with Sturmers in the semi-commercial-scale stores following remodelling of the air-distribution system, but the gas-tightness of the stores declined as the season progressed. Under these conditions the fruit kept much better than the ordinary cool-stored controls, but were not up to the standard that otherwise might have been reasonably expected.

Effect of D.D.T. Sprays on Cold-storage Quality of Apples.—Sturmer apples sprayed with D.D.T. were compared with similar fruit sprayed with lead arsenate. Applications of D.D.T. at a concentration of either 4 oz. or 8 oz. per 100 gallons were found to have no detrimental effect on storage quality.

Effect of Fertilizers on Cold-storage Quality of Apples.—Cox's Orange with phosphate and potash in addition to nitrogen developed less breakdown and fungus but more scald and pit than those with nitrogen only. With the Jonathan, increasing amounts of nitrogen reduced the storage quality, and the absence of potash again lowered storage quality. Delicious remained virtually unaffected by manurial treatments. Nitrogen unbalanced by phosphate and potash again greatly reduced the storage quality of Sturmers, but the complete-treated fruit was as good as the untreated controls.

Cold-storage Quality of Coloured Strains of Apples.—This year rather more than usual of the red strains of Delicious fell into the high-keeping-quality class and most of the seventeen samples kept better than the standard type. A red strain of Jonathan kept as well as the standard type.

Effect of Rootstock on Cold-storage Quality.—A moderately good sample of Jonathan was available, and this season M XV replace M XII as the best stock, being considerably more resistant to breakdown. M I and Northern Spy were relatively very inferior.

General Refrigeration Research.—The fruit-cold-storage staff co-operated in investigation of temperature conditions in the refrigerated holds of overseas ships. The work is under the control of the Refrigerated Cargo Research Council of Great Britain, and involved the placing of large numbers of distant-reading thermometers throughout the cargo during loading, and the extensive taking of temperatures of cargo on its arrival at the ship's side. The work has already shown the need for improvement in local transport of frozen produce, and information has consequently been obtained from overseas on the latest design of insulated railway wagons for the transport of frozen produce.

FRUIT RESEARCH

Research Orchard, Appleby

Manurial Investigations.—The biennial bearing habit of Cox's Orange, Dunn's Favourite, and Delicious apples has been responsible for an exceedingly light crop, but the value of nitrogen and also phosphate and potash in lessening the severity of crop reduction has been amply demonstrated.

Rootstock Trials.—Previous years' results have, in general, been confirmed.

Varietal Trials.—The vitamin C content of the whole range of hybrid varieties has been found by the Plant Chemistry Laboratory to be at a substantially lower level than last year.

Plant Diseases Division

I. *Pomology*

(*a*) *Rootstocks.*—(i) *Apples*—Sturmer: On clay soils Malling XII and own-rooted Sturmer have given grop increases of 59 per cent. and 53 per cent. respectively in comparison with check trees on Northern Spy. In a trial on light volcanic soil between trees on Sturmer roots and on Northern Spy, the former gave a 200 per cent. increase in yield over the latter.

Jonathan, Cox's Orange, Pippin, and Gravenstein gave results almost comparable with those published last year.

Dougherty: Special trials have been conducted with four woolly-aphis-immune Merton stocks, and one shows definite promise as a more vigorous substitute for Northern Spy.

(ii) *Citrus:* New stock and scion workings with experimental material have resulted in great improvement in the quality of some of the fruit.

(*b*) *Variety Investigations.*—Work has been continued on variety trials of apple, peach, and citrus. Some new material—mandarins—has been received from Japan.

II. *Plant Diseases*

D.D.T. was found to be outstanding in the control of codling-moth, but other pests such as red mite tend to increase after application. Further studies are being made.

No completely satisfactory method of control of red mite has as yet been found. Trials are in progress to control mealy-bug.

Dicky-rice weevil has been successfully controlled with sprays of 0·05 per cent. p.p.i. D.D.T.

Brown-rot on Golden Queen peaches has been satisfactorily controlled with "Phygon" applied twenty-one and seven days before picking.

Bordeaux (1–2–100 or 3–6–100) gave good control of bacterial-spot of plums, but resulted in foliage injury.

Mercurated lead arsenate is the only therapeutant showing promise in checking apple black-spot without causing plant injury.

Stony-pit of pears has been found to be graft transmissable and not a physiological disease.

III. *Frost Investigations*

The freezing of apricot buds artificially *in situ* demonstrated the practicability of this method for determining critical temperatures. Preliminary results suggest that temperatures are critical at 1° F., and at this temperature severe damage occurs within ten minutes.

Cawthron Institute, Nelson

Trees treated with magnesium compounds are still showing to advantage over trees not so treated.

A considerable amount of detailed information has now been accumulated on the plant-food status of the permanent manurial block at the Appleby Research Orchard and Dougherty leaves and apples at the Annesbrook Orchard. This is being prepared for publication and release to the fruit industry.

The value of nitrogen and phosphate in maintaining growth of raspberry-canes and increasing yield of fruit has been clearly shown.

Cox's Orange trees in the Tasman-Mariri area are being increasingly affected by a disease known locally as "collar-rot." Initial investigations have been concerned with the identification of the disease organisms involved.

Additional studies have been undertaken on (i) zinc and minor-element deficiencies, (ii) chlorosis of Delicious trees, and (iii) raspberry and Cape gooseberry diseases.

Miscellaneous

The Plant Chemistry Laboratory has examined the packaging of dehydrated apples and has found that a moisture-vapour-proof cellophane overwrap is an important factor in preventing the loss of sulphur dioxide from the product.

The Chemical Engineering Section of the Dominion Laboratory is engaged on the design of equipment for the mechanical filling of dried apple slices into cartons.

HOPS RESEARCH

During the year representatives of the Hop Marketing Committee and the Brewers' Association of New Zealand (Inc.) approached the Department with a request for the establishment of a research organization. Hop crops were being seriously threatened with disease, and other specialized problems needed attention.

A Hop Research Committee has been formed with representatives from the above two initiating bodies, together with the Department and Council of Scientific and Industrial Research, Department of Agriculture, and Cawthron Institute.

Land is being sought to establish a Hop Research Station, and a Director has been appointed. The latter has now proceeded to United Kingdom to gain specialized experience.

Preliminary surveys have confirmed that root-rot disease is a major immediate problem, and a programme of research commenced.

An officer of the Dominion Laboratory (Chemical Engineering Section) made an initial survey of hop-kilns in New Zealand, and a visit was made to Tasmania to study hop-curing practice. Indications are that considerable improvement should be possible in the efficiency of current drying methods.

The research programme also envisages work on improvement of varieties, cultural methods, manurial practice, and soil surveys.

INDUSTRIAL PSYCHOLOGY DIVISION

Research

The report, "Girl Workers in New Zealand Factories," has been published and favourably received both locally and overseas.

A survey of the present trend towards decentralization in New Zealand industry has been commenced.

The use of psychological techniques for the selection of personnel in some of the skilled ground-staff trades of the R.N.Z.A.F. has been investigated. Analysis showed a very high degree of validity for the technique employed.

Two research projects begun last year, (1) a study of the adjustment of youths leaving school to the industrial environment and (2) an occupational analysis of some building trades, have had to be curtailed due to time required on servicing work.

Service.—Investigations, surveys, and other services have been carried out at the request of twenty-one firms and organizations, and a wide range of topics covered. The practical value of the work has been confirmed by the management and reflected in improved efficiency and production in almost all cases.

Vocational Examinations.—Some 190 vocational examinations have been conducted. The Occupational Clinic, established to give assistance to persons maladjusted in their working-life, has continued to function.

Education and Information.—The dissemination of information on topics investigated by industrial psychology has been by medium of answers to specific inquiries, lectures, and pamphlets.

Future.—The Division will shortly be disbanded and the balance of staff transferred to the Personnel Advisory Division of the Department of Labour and Employment. A small occupational psychology research unit will be formed within the Department.

LEATHER AND SHOE RESEARCH ASSOCIATION

Leather Research Association

Wear of Sole Leather.—Field trials have been continued to find how the method of testing the wear of sole leather may be improved to give more rapid results.

Waterproofing.—Different methods of sulphurizing or "vulcanizing" oils have been examined without success in an endeavour to produce a permanent waterproofing effect.

Deterioration of Upper Leather in Wear.—Analyses of shoe uppers which have gradually developed cracks over a fair period of wear has shown that dirt, tanning-material, hard waxes, and salts have accumulated in the surface fibres of the leather. Methods are being investigated to increase the useful life of upper leather based on these findings.

Curing of Calf-skins.—Suitable modifications have been introduced into works practices to avoid hard spots consisting of calcium carbonate appearing on the flesh of cured calf-skins during storage.

Routine Work.—Checking of factory processes, raw materials, and finished leathers has, as usual, been carried out during the year.

Shoe Research Association

Threads.—A survey of the various brands of sole-sewing threads was made to determine their quality with regard to strength and stretch. In the main, threads in use were quite satisfactory.

Factory Problems.—Technical problems concerned with finished articles, finishing processes, and processing have been dealt with regularly. Causes of failure of footwear in service formed another large group.

MANUFACTURERS' RESEARCH COMMITTEE

The Committee has continued actively to promote research in New Zealand's manufacturing industries.

Research Associations.—The primary long-term function of the Committee must be the application of research in industry, and increasing stress is therefore being laid on the establishment of co-operative industrial research associations, which have proved successful in the United Kingdom and are being adopted in other parts of the British

Commonwealth. Close contact has been maintained with the research associations already formed, and secretarial assistance is provided for two. To ensure the maximum interest from industry and that the work is the most pertinent to the needs of industry, research associations are being encouraged to become incorporated. Progress in respect of the laundry, dry-cleaning, and dyeing industry has been slow as, although almost all institutional laundries have joined, a number of the larger commercial firms have withheld their support. Discussions regarding the application of research have, at the request of the industry, been held with the precast-concrete manufacturers.

Scientific and Technological Service to Industry.—For the benefit of the industries which have not yet formed their own research associations, or to provide special services and facilities not elsewhere available to industry, the Committee has encouraged the laboratories of the Department to help manufacturers wherever possible and has kept in contact with the work done through its representation on the Advisory Committees of the Dominion Physical Laboratory and the Auckland Industrial Development Laboratories and through special reports made available to it. Certain routine services are being maintained, of which manufacturers are taking considerable advantage.

It is gratifying to report that, in addition to much scientific work which will undoubtedly be of general value to industry, 75 per cent. of the work of the Auckland Industrial Development Laboratories, 30 per cent. of the financial recoveries by the Dominion Physical Laboratories, and 30 per cent. of the working-time of the Dominion Laboratory are specifically in relation to requests from and assistance to industry.

Particularly keen interest has been shown in the fuel efficiency service of the Dominion Laboratory (see page 27), which the Committee has continued to sponsor to the very great advantage of industry.

Information Services.—The Committee has encouraged manufacturers to avail themselves of the technical information coming to hand from overseas to the Department's Information Bureau, and has taken a keen interest in the *Industrial Bulletin* (see page 33). In conjunction with the Bureau, arrangements were made during the year for participation in industrial fairs in Christchurch and Wellington and the Otago Centennial procession.

A long-range programme of research has been recommended to the Department, and the manufacturers' associations have been asked to suggest further long-range research projects of particular interest to industry.

The Committee has maintained close connection with the Industrial Psychology Division and has also been represented on the Scientific Man-power Committee (see pages 12 and 38.)

NEW ZEALAND POTTERY AND CERAMIC RESEARCH ASSOCIATION (INC.)

The progress made during 1947 has been disappointing, due to lack of suitable premises and equipment.

The laboratory work upon the eight clays chosen as most representative of those in general use has proceeded, the results having been reported in three technical reports.

The period following the arrival of the present Director at the beginning of September has been utilized in becoming thoroughly familiar with the personnel, factories, products, and raw-material deposits of New Zealand.

The constitution has been reconsidered and redrafted to widen the activities and interests of the Technical Committee. This should give closer relations between the Research Association and its staff and the technical and production side of the industry.

Visits have been made to all establishments of members of the Association for consultation. The main raw-material deposits have been examined, and considerable time has been spent in assessing the position here in New Zealand before undertaking any plan of research.

NEW ZEALAND WOOLLEN-MILLS' RESEARCH ASSOCIATION (INC.)

As in previous years, much time has been devoted by the staff to problems and investigations submitted by the mills. Among this work there has been a considerable amount of routine testing of samples for properties such as shrinkage, yarn levelness, fibre fineness, abrasion resistance, and shower-proofing. This service is being steadily used by the mills in order to check their own standards.

Handle of Wool.—A main investigation now in progress is the effect of various "softening" agents on the handle of untreated wool. A fabric made from 56's quality wool is being used and treated pieces are being assessed for handle by several observers.

Softening agents are also being applied to samples treated with papain or chlorine, where their effect is more marked.

Papain-finishing.—A considerable amount of laboratory work has been done throughout the year, and a preliminary trial has been conducted at one mill, whilst another is preparing to make more extensive trials. Both treatment by papain and peroxide (perzyme) and papain after dry chlorination (chlorzyme) have been investigated. A mill trial of the latter process on some pieces of knitted fabric made from wool chlorinated as tops gave a superior finish after processing.

Loose wool has also been "chlorzymed," giving a filling suitable for quilts which may be washed without felting. With the co-operation of certain mills, such treated wool has been made up into sample quilts for an exhibit prepared on behalf of the Wool Board.

RADIO RESEARCH

The Radio Research Committee has continued to exercise its functions of reviewing, co-ordinating, and promoting radio research in New Zealand. The Committee assists in advising the Department on the conduct of researches of value to the radio communication authorities in the Dominion.

Ionosphere Activities.—The Committee has continued its general oversight of the ionosphere activities of the Department, comprising the ionosphere analysis and recording section at Christchurch and the four stations at Lincoln, Christchurch; Campbell Island; Rarotonga; and Suva. The ionosphere work is a permanent scientific service of the Department.

Seagrove Radio Research Station.—The necessary authority for the establishment of this station has now been sought from Government.

Microwave Propagation Research.—An officer of the Postmaster-General's Department, Melbourne, Australia, visited New Zealand to discuss on a collaborative basis a programme of measurements, with equipment obtained from the United Kingdom, on propagation conditions at frequencies normally used for radar. The Committee recommended for approval a New Zealand programme of investigations in this sphere in collaboration with Australia.

Research on Solar Phenomena affecting Radio Communications.—The Committee gave detailed consideration to the co-ordination of research by various organizations in New Zealand on such phenomena as sunspots, auroral effects, and magnetic and ionospheric effects, all of which have a disturbing influence on radio communications.

Other radio research matters considered by the Committee included radars for New Zealand coastal shipping, the establishment of a radio research office for the co-ordination and analysis of various aspects of radio research, and New Zealand representation at and presentation of papers to the British Commonwealth Scientific Specialist Conference on Radio Research, to be held in London, August, 1948.

RESEARCH INSTITUTE OF LAUNDERERS, DRY-CLEANERS, AND DYERS OF NEW ZEALAND (INC.)

This new organization was incorporated on 9th December, 1947, there being twenty-three industrial, thirty-two institutional, and six ancillary members. Group affiliation has been arranged with the British Launderers' Research Association, the Canadian Research Institute of Launderers and Cleaners, the American Institute of Laundering, and the National Institute of Cleaning and Dyeing (U.S.A.). The technical and news bulletins of these organizations are being received regularly, in most cases in sufficient numbers for direct distribution to all members interested. Information likely to be of interest has been collated from various sources and sent to all members in a series of information circulars.

Applications for directorship of the Institute were invited from United Kingdom and Canada as well as locally, but as the financial basis of the Institute has not been approved (mainly on account of lack of legislative authority for Hospital Board contributions) no appointment has been made.

TOBACCO RESEARCH

The Director of the Station, on the invitation of the Chief, Plant Bureau, C.S.I.R., Australia, attended a Conference at Brisbane of tobacco technical officers attached to Commonwealth and State services in Australia.

Reports submitted to this Conference and the subsequent discussions indicated that the research programme so far carried out in New Zealand was sound and that the application of the results in the industry was considerably ahead of Australia.

A disastrous flood in the latter part of the season affected the results of a number of the experimental plots and the yield and quality of the leaf.

Research Work

The research work in the past season, as in previous years, has been a co-operative effort carried out jointly by officers of the Cawthron Institute and of the Tobacco Research Station. Work conducted by the Institute has included chemical investigations relating to intake of plant nutrients and chemical composition of the tobacco leaf in the fertilizer and curing experiments; disease surveys and investigations concerning their dissemination and control; tobacco soil surveys and the chemistry of tobacco soils.

Work at the Tobacco Research Station has included all types of fertilizer investigations, variety trials, seed-production work, plant breeding, and disease and curing investigations.

Valuable assistance was given by the Chemical Engineering Section of the Dominion Laboratory in devising kiln improvements for the more efficient curing of tobacco.

Details of the research results have been published during the year in a series of papers in the *New Zealand Journal of Science and Technology*, and further papers are in preparation.

The area of land for growing tobacco has shown an increase of 330 acres over that for the 1946–47 season.

WHEAT RESEARCH INSTITUTE

Wheatgrowing.—In the 1947 harvest the area of Fife-Tuscan grown increased by 2 per cent. of the total wheat area to 13·9 per cent., while Cross 7 was grown on 66·9 per cent. Varieties produced wholly or partly by the Institute now occupy about 85 per cent. of the total wheat area of the Dominion.

Wheat-breeding.—Two new varieties bred by the Institute are now being distributed. The first is WR1-Yielder, which in thirty-seven trials conducted over the last seven years gave yields higher than those of Cross 7 by 4½ bushels per acre. The first commercial increase area (of 8 acres) will be sown in South Canterbury this autumn from seed supplied by the Institute. Four areas of the second new variety, Hilgendorf, were grown by farmers, all of whom were well pleased. One of the outstanding features of the new wheat is its early maturity; baking-quality and protein content of trial samples were again better than Cross 7.

New lines under test include 192,01, which so far has outyielded Cross 7 by a substantial margin.

Cereal Chemistry Milling and Baking.—Full-scale commercial milling and baking trials of Hilgendorf flour were made this year, using 25 per cent. of the new flour blended with ordinary flour. The general opinion formed is that the new wheat will make a marked improvement in the palatability and keeping-quality of the country's bread, being particularly valuable for week-end bread. One hundred and seventy sacks will be available for distribution for trails in the coming year.

Chemical and Research Work.—The investigation into the factors responsible for the dark crumb colour of bread from 80 per cent. extraction flour has been continued and widened to include other aspects of flour quality.

Routine testing of wheat and flour for millers and bakers has increased, due to difficulties associated with 80 per cent. extraction flour.

The Institute has assisted the Wheat Committee in its control of flour quality.

Two short courses for bakers were held during the year.

CAWTHRON INSTITUTE

The following reports relate to land-utilization, chemical work, and tomato investigations carried out by the Institute. Other work is published under the headings "Tobacco Research" (see p. 16) and "Fruit Research" (see p. 11), while entomological work is included in the report of the Entomology Division (see p. 30).

Land-utilization.—Mechanical and chemical analyses of soil samples from the Tapawera locality have now been completed, enabling soil maps to be drawn. Soil mapping of the Stanley Brook locality has been commenced, this being the last tobacco area in the Waimea County which remains to be completed. Tobacco soil maps of these areas should be available shortly.

The reconnaissance soil map of the Waimea County has been revised and will shortly be published with an account of the major soil types.

Plant-food Status of Tomato Soils.—Detailed studies have been continued on the effect of steam, chloropicrin, and D.D. on the nitrogen and base status of tomato soil subject to these treatments. It would appear that the three treatments produce conditions in the soil favouring an ammonia nutrition of the tomato plants, as compared with nitrate nutrition on the unsterilized soil.

Tests with Steam and Soil Disinfectants on Yield of Tomatoes.—Results of previous years were largely confirmed. D.D., formalin, and Gammexane gave poorer results than steam and chloropicrin.

Effect of Compost and other Materials on Tomato Yield.—Compost again gave outstanding results. Cocoa-bean husks were also beneficial.

Tomato "Cloud."—Studies on the incidence of "cloud" in Nelson tomato-houses have been continued, and some new varieties obtained from Cheshunt Tomato Station in England were tested for susceptibility to "cloud." Much valuable information has been accumulated concerning the soil moisture and air temperatures favouring "cloud," but further work is necessary before a full answer can be given.

Hard-core.—Results recorded last year have been confirmed. Chloropicrin reduces to almost negligible amount the occurrence of hard-core.

Plant Nutrition Investigation.—During the past year main attention has been given to the chemical composition of apple leaves and fruits grown under different fertilizer programmes, the cause of chlorosis of Delicious apple trees, chemical methods for the estimation of zinc, and the iron and manganese status of Nelson tomato leaves.

RESEARCH WORK AT AGRICULTURAL COLLEGES

Grants were made by the Department during the year to Canterbury and Massey Agricultural Colleges for a number of projects which are reported below.

CANTERBURY AGRICULTURAL COLLEGE

Microbiology

Crop Diseases. –The fungus responsible for an increasingly prevalent foliage disease of field and garden peas has been isolated and studied.

In the third season of field sowings of disinfected Massey peas, germination improvement over controls was demonstrated only when soil conditions were wet following sowing date. Used crankcase oil, Spergon, Tetroc, and copper-carbonate - Cuprox treatments improved germination.

The percentage infection of standard wheat varieties with eyespot disease when grown on infected plots has been recorded. Cross 7 was most susceptible (91 per cent. infection) and Tuscan least (75 per cent. infection). Other results were similar to those recorded last year.

Over 200 commercially dry dusted samples of wheat have been examined. Over 40 per cent. of the lines carried less than 1 oz. of dust per bushel (sellers guarantee 2 oz. dust per bushel). The dusting machinery has been found to be faulty.

One hundred and ninety farmers' samples of 1947 harvest grain from throughout the wheatgrowing area were examined for covered smut. One hundred and fifty-six revealed no smut present.

Studies were continued on rye-grass blind-seed and the usual disease survey was undertaken.

Soil Microbiology.—*Actinomyces* species of soil origin have been studied and techniques for studying *Azotobacter* are being developed.

Bacteriology. Bacteriological examinations were made of samples from 6,000 gallons (115 herds) of milk for town supply.

Wool Research

The following projects have been continued : wool survey, early shearing, progeny tests, and manufacturing trials. Data is being steadily accumulated in most cases.

Information on the incidence of mycotic dermatitis in one flock in different seasons is being collected. There is evidence that the disease frequency sets up conditions conductive to fly strike.

Veterinary Work

Much work has been undertaken on a special kind of lameness following dipping in Rotenone-bearing powders and Gammexane dips. A report will be published shortly in the *Australian Veterinary Journal.*

Recent work has been concerned with the use of rubber bands for castration and a patent crushing type of tailing-instrument. Neither of these methods show any differential effects on subsequent growth when compared with "knife" tailing and castrating.

The progeny testing of Southdown rams shows that heritable differences between sires of various qualities and from different studs are small.

Lime and Liming

Chemical analysis of samples from thirty-one South Island commercial limeworks showed that these agricultural limestones are very low in magnesium and phosphate. Fineness of grinding varies considerably.

Other studies include rate of solution in relation to fineness of grinding and physical properties, lime status of college farm lands, response of crops to soil acidity, and bulk lime-spreading.

Copper-deficiency Studies

Using onions as a test crop, work was carried out on the copper-deficient peat land north of Christchurch. Two foliar spray applications of 20 lb. per acre of copper sulphate gave excellent results.

Soils and Fertilizers

The soil-fertility project initiated in 1946–47 has been carried forward. The crops for each stage in the four-year rotations were sown and harvested. The autumn-sown wheat plots made even growth and all gave high yields of grain. There was no significant difference between controls and fertilizer treatments.

A general report covering the soils and agriculture of Westland was completed and recommendations for land-development, pasture-improvement, and dairy-herd-management presented.

Entomological Work

The methods of over-wintering of Hessian fly are still being investigated.

The results of several years' work on wheat insect pests have been submitted for publication.

A study of grain-store weevils has been commenced.

Animal Husbandry

Routine progeny testing in two flocks is proceeding and much valuable data are now being obtained concerning the inheritance of sheep characteristics. The merit sire scheme for Corriedales based on progeny test has completed its first year.

The sheep-dipping trials using Derris, D.D.T., and benzene hexachloride (Gammexane) have been completed. Gammexane has been shown to be outstanding in its effectiveness against both keds and lice and in its period of toxicity.

The growth and development studies on sheep raised on high and low levels of nutrition and ruminant digestion studies have been continued.

Farm Machinery

Several models of the truck-mounted grass-seed stripper developed at the college have been giving satisfactory service in commercial use.

A tractor-mounted rotary topper was constructed and tested. It has proved very promising for topping heavy growth on pastures, even in tough conditions.

A ditch-cleaning machine mounted on a tractor has been developed and is being tested.

A beginning was made with a project aimed at improving the efficiency of harvesting and threshing white-clover seed.

MASSEY AGRICULTURAL COLLEGE

Biochemistry

Milk-supply of Romney Ewe. The results of the past five years have been submitted for publication. During last lambing season a start was made with recording milk yields of two-tooth ewes—these animals will be under study for five or six years.

Wear in Sheep's Teeth.—An account of this work was presented in the *Proceedings of the Tenth Annual Meeting of Sheep-farmers*, published by Massey College in 1947. Tentative conclusions are as follows :—

(*a*) The main factors responsible for " poor mouths " are abrasion especially caused by toughness of pastures, overstocking, drought conditions, and, under certain conditions, high-fertility pastures.

(*b*) There is no evidence that good teeth differ structurally from poor teeth or that mineral deficiency is concerned.

Further work is in progress.

Research on N-type Sheep

Further understanding has been gained of the inheritance of N-type sheep, characterized ordinarily by both hairy birthcoat and hairy fleece. It is now possible to determine by inspection of the birthcoat whether a sheep will breed true or not for hairiness. The breeding of hairy sheep is now relatively simple, and the flock is now in the hands of a commercial firm interested in the production of carpets and rugs from the skins. Five papers have been submitted for publication.

Sheep Parasitology

The effects of weather on the acquisition of parasites by sheep has been studied. A comprehensive treatise on parasites in sheep is in the press.

Propagation Research

Work on the use of CO_2 gas in propagating has been continued. A commencement has been made on investigating stock and scion relationships in rhododendrons, also a considerable number of experiments on grafting these plants. Work is still being done on azalea cuttings. Preparations containing napthalene acetic acid in concentration as high as 1 in 10,000 have assisted the rooting of daphne cuttings, whereas all preparations containing indol-butyric acid were harmful.

Drainage Research

The general report on the outflows from a back filling of mole drains and the operations of the " Roteho " tile-trench-digging machine confirms the previous year's observations.

Sheep and Wool Department

A progeny-testing experiment was commenced in March, 1947, and was designed to investigate the heritability of productive qualities in sheep, the problems of progeny testing, and in particular the repeatability of progeny tests of Romney rams in different seasons.

Trials of the carrying-capacity of short-rotation rye-grass and pedigree rye-grass have confirmed the early but short benefit derived from the former grass.

The analysis of the data accumulated by the Fleece Testing and Recording Department has been continued and a number of papers prepared for publication. Data pertaining to the fertility of sheep have been analysed. The influence and relative importance of season, sire, type of birth, &c., on birth weight and growth rate in lambs, as well as heritability of body weight, are being studied.

BRANCH REPORTS

AGRONOMY DIVISION

The general programme of field-crop improvements reported in previous years was continued. To provide nucleus stocks of pure seed for certification purposes, reselected lines of the main varieties of wheat, oats, malting barleys, rape (new type certified B.L.E.), kale, and garden peas were grown.

Additional hybrid material is still under test in the following crops :—oats, barley, kale, swedes, lucerne, lupins, garden peas, and field peas.

Some of the points of interest arising from the breeding programmes are as follows :—

One of the new varieties of oats being tested exhibits a high degree of resistance to lodging.

The aim of the breeding programme with barley is to produce a type for direct heading and select a suitable green-feed type.

Two winter types of rye-corn performed well in comparison with various lines of green-feed barley and oats. Wong barley also showed distinct promise.

The club-root-resistant strain of rape distributed last year has shown excellent resistance in field trials, and it is anticipated there will be a great demand for seed.

The "Dryland" variety of swede has proved most suitable for areas of low rainfall and has been taken over by the Department of Agriculture for multiplication and distribution.

The main effort with lucerne is now being directed towards the development of a satisfactory grazing type.

Work continues on the development of varieties of linseed and linen flax immune to New Zealand strains of rusts.

Supplies of the new sweet flowering lupin were distributed to the Department of Agriculture, and reports suggest that it is slightly more vigorous than the sweet blue lupin, from which it was derived.

The breeding-work on garden peas and field peas has been carried forward as reported in 1947 report.

Special Activities

Potato Research Section.—A survey has been made of the main potato-growing areas to find the requirements of each district and the problems needing urgent attention. A wide range of local commercial varieties, some pre-war hybrids, and much new material from Great Britain, Germany, and the United States of America will form the basis of the breeding programme. The latter will include breeding for blight resistance, resistance to virus diseases, frost resistance, and characters of high yield, quality, drought resistance, and adaptability to New Zealand conditions.

Inadequate glasshouse space is stultifying the whole programme.

Vegetable Research Section.—A wide range of vegetable varieties is being grown to obtain material for selection and breeding and also to test stocks for New Zealand seedsmen.

Other Activities

Weed Control.—Agroxone has now replaced Sinox in our routine spraying of nucleus-seed crops of linen flax and linseed for control of fat-hen and other weeds. It is less sensitive than Sinox to variations in temperature and humidity, is not so readily washed off by rain following application, and does not stain hands and clothing.

The problem receiving most attention is the control of such troublesome perennial weeds as Californian thistle and blackberry, and in this considerable progress has been made. Many factors influence the results, notably the time of year and stage of growth at which the weed-killer is applied, amount of soil moisture present, and possibly humus content of the soil and general nutrient status.

Although for many purposes the hormones are preferred to Sinox, the latter has special value in controlling black bindweed (*Polygonum convolvulus*) and black nightshade (*Solanum nigrum*), particularly in pea crops, because these weeds are readily killed by Sinox but not by the hormones, whereas peas are resistant to Sinox but rather susceptible to the hormones.

APIA OBSERVATORY

The first stage in the carrying-out of a scheme in which the staff of the Christchurch Magnetic Observatory are each to spend periods of two years in Samoa has been reached.

Time Service.—Daily checks on all timepieces by means of radio time signals have been carried out.

Terrestrial Magnetism.—International magnetic character figures and the "K" indices of geomagnetic activity have been supplied monthly to Carnegie Institution, of Washington, also descriptions of magnetic disturbances for publication.

Seismology.—Quarterly reports of earthquakes have been forwarded to a number of observatories throughout the world.

AUCKLAND INDUSTRIAL DEVELOPMENT LABORATORIES

The main trend of the work undertaken by the Auckland Industrial Development Laboratories during 1947 has been increased assistance to local manufacturing firms covering a wide range of industries.

Since the inception of the Laboratories a little over two years ago, over 1,100 jobs have been undertaken (approximately 75 per cent. for local industry).

A *cross-section* of the work handled by the Laboratories during the last twelve months is set out below :—

Special tools, gauges, and fixtures for the production engineering and metal trades groups.
Control and investigational equipment for the textile groups.
Dies, machinery, and control equipment for the plastics industry, as well as testing of finished products.
Optical components for the motion-picture and photographic trade.
Equipment and plant for the chemical-engineering industry.
Assistance to the electroplating group.
Checking of products and assistance with technical difficulties of merchants and importers.
Tools, control equipment, and testing for the building trades and woodworking industry.

Research Projects

Frost Protection.—A considerable amount of preliminary work has been done on the engineering aspects of frost protection for winter crops in Auckland. An experimental installation of smokeless orchard-heaters was installed at Avondale and used for frost protection of passion-vines. A 14 ft. horizontal frost fan was constructed, but was installed too late in the season to obtain satisfactory data under frost conditions. This work will be continued and intensified.

Air-conditioning of Glasshouses.—The installation of a number of experimental glasshouse heating and air-conditioning units has been completed with the co-operation of the Plant Diseases Division. These are being operated for a period to obtain sufficient data for further developmental work.

Measurement of Pulse-rate and Blood-pressure during Anæsthesia.—An experimental pulse-indicator is at present undergoing practical tests.

BIOMETRICS SECTION

Research.—The theoretical work on the design of identical-twin experiments has been completed and four papers are ready for publication. Studies have been made of the accuracy of various sampling methods to estimate the lactation yields of dairy cows, the day-to-day variation in a cow's performance, and the accuracy of double-reversal trials in dairy experiments.

Biometrical methods have been devised so as to enable the shapes of lactation curves to be treated statistically.

Advisory Duties.—Virtually all branches of the Department have sought biometrical advice from officers of the Section. The variety and volume of such requests has increased considerably over the past year. Outside institutions who have consulted the Section include Department of Agriculture, Agricultural and University Colleges, New Zealand Dairy Board, and National Library Service.

Punched-card Work.—Typical of the work done on the present punched-card machines are the analyses of six thousand sets of measurements on wheat plants for the Wheat Research Institute and of twelve thousand records from Wool Metrology.

Advantage was taken of discussing modern mechanical computing devices and their applicability to the work of the Section with Dr. L. J. Comrie, managing director of Scientific Computing Service Co., London, when he visited New Zealand recently.

Development of the Section.—Long-term plans for the development of the Section are being implemented as opportunity arises. The Section has now two officers studying at Cambridge University.

BOTANY DIVISION

Over 3,000 specimens were reported on and important additions and alterations were made to the herbarium.

A detailed study of the habitat forms of native blue-grass, blue tussock, silver tussock, and hard tussock have been undertaken to secure improved types of these native grasses for tussock-grassland renovation. The whole of Molesworth Station is periodically examined. Detailed work on the permanent plots yielded evidence on the progress of regeneration and a history of regrassing trials in tussock-grassland has been prepared for publication.

A new edition of the handbook of naturalized plants is in preparation and a bulletin on poisonous plants completed.

Field studies of (*a*) the significance of seaweed, (*b*) food plants of wild life, (*c*) floral development of the southern beech, and (*d*) vegetation surveys in the Wellington Province, Wither Hills, Mid Dome, and the Dunstan Mountain plots have been undertaken.

Studies on atmosphere-borne pollen were continued, these being related to the treatment of hay-fever, honey quality, and peat investigations. Some of the pollens collected during the previous season have been used for clinical testing of hay-fever patients. Pollen types of importance were described and demonstrated to a conference of beekeepers.

During the year the Division was made responsible for the co-ordination of all phormium (New Zealand flax) research undertaken by the Department. Work has been concentrated on yellow-leaf disease, which is making serious inroads into both the natural and the artificial stands on the Moutoa Estate. The cause remains unknown.

The present decline in the amount of agar weed collected was not found to indicate any over-picking of the beds. Promising new localities were discovered. The visit of the eminent Swedish algologist, Dr. Lore Levring, will greatly assist all seaweed work in this country.

A plant introduction service has been put into operation.

DEFENCE DEVELOPMENT SECTION, CHRISTCHURCH

The change-over of the Defence Development Section to the Canterbury College Industrial Development Department is proceeding and an Advisory Committee has been elected.

The assembly and testing of three aerial structures for meteorological radar sets has been completed.

A further batch of seven meters for measuring moisture in wheat grains has been completed to order.

At the request of the Wheat Research Institute a machine has been developed to count wheat grains. Considerable experimental work was necessary to obtain a satisfactory method of separating the grains sufficiently. The counting is then done by photo-tube and relay. The accuracy obtained is about 0·2 per cent. with a speed of 200 grains per minute.

A small belt-type dough-moulding machine was designed and produced for the Wheat Research Institute. Development is now proceeding for a bun-moulding machine.

For the various departments of Canterbury University College a large amount of work has been done on the construction and repair of scientific laboratory equipment.

DOMINION OBSERVATORY

Control of Clocks.—A new method of automatically recording wireless time signals resulted in the maintenance of a higher standard of accuracy in time control.

Time Service.—The usual time service was maintained. The number of telephone calls for correct time was just over two thousand, exceeding that of the previous year. The increase was probably due to the frequent stopping of electric clocks by power cuts. The Government Buildings' clock was checked daily and regulated when necessary.

Seismic Activity.—In all, 233 earthquake shocks were reported felt during the year, which was a comparatively active period.

Numerous shocks originated off the north-east coast of the North Island, a strong one on the 26th March, 1947, being followed by seismic waves which caused damage on parts of the Gisborne coast. A later shock in the same area produced sea-waves of smaller intensity.

The strongest shock of the year occurred in the Jackson's Bay region on the 13th October. It reached intensity M—MVII ½ in the epicentral region and was widely felt in the South Island.

Gravity Survey.—The Observatory co-operated in a gravity survey of New Zealand carried out during the year.

DOMINION LABORATORY

The amount of chemical work for Government Departments that the Laboratory is called upon to do continues to increase, and advisory and research work for industry is also increasing rapidly.

The total number of samples dealt with for the year was 26,816, as compared with 25,103 in the previous year. Of these, 19,046 were forwarded by the Health Department and 2,376 from various branches of the Department.

The work of the Laboratory is briefly summarized below :—

Rocks, Minerals, and Clays

A thorough examination was made of cementmaking raw materials collected by the Geological Survey from Southland. Regular tests of New-Zealand-made cements for compliance with British Standard specifications were carried out.

The value of a greensand (recently found near Paraparaumu) as a flux for incorporating with phosphate rock by the fusion process has been investigated, and a works trial is under way.

Samples of glass-sands from the deposits at Mount Somers and Parengarenga are being tested.

Other studies have included the following: raw materials for tilemaking, New Zealand diatomite as a filtering agent, brickmaking and refractory clays.

A considerable amount of work has been devoted to analyses, &c., of radio-active isotopes.

Food and Drugs

Milk.—The supply to Wellington City was very satisfactory in quality, but other supplies in the Wellington Province were not so good.

In Auckland the milk-supply in several districts has continued to be unsatisfactory.

The milk supplied to Christchurch City is generally of very satisfactory quality, but some of the supplies continue to be low in solids other than fat.

In the Otago District there has been a marked improvement in the fat content and fewer watered milks were recorded. The proportions of stale and improperly pasteurized milk increased greatly, but this position has now improved. The question of staleness and of visible dirt needs attention.

Water.—Regular examinations were made of water-supplies throughout the Dominion to keep a check on their purity for domestic use. Bacteriological examinations are regularly carried out by the Christchurch Branch of the Laboratory, but in the other centres only chemical analyses are made.

Determinations of fluorine in New Zealand waters have been made and the amount present is generally low. A low fluorine content may possibly have an adverse effect on the formation of sound teeth.

Food and Drug Samples other than Milk.—A very large number of samples covering practically all kinds of food were analysed in the four laboratories. A number of food products analysed did not conform to standards laid down in the regulations, indicating the need for constant checking.

Many products were found to be labelled in a misleading or unsatisfactory manner, and appropriate action was taken by the Department of Health.

Insect infestation of foods was detected in a considerable number of instances, indicating that the standard of care in handling goods has deteriorated.

During the year a comprehensive survey of drugs, galenicals, pharmaceutical preparations, and proprietary medicines for determination of quality was commenced. In general the drugs on the market were of reasonably good quality, but in some instances there was considerable room for improvement.

Organic

Samples for analyses included insignis-pine wood for determination of resin content, kauri gum, oil from phormium-flax seeds, and rubberware for aircraft and milking-machines.

Numerous inquiries were received from Government Departments and from industry for information concerning plastics, rubber, adhesives, textiles, and paper.

The investigation of the acid hydrolysis of waste wood was continued.

Toxicology

Poisons detected in police specimens included aspirin, barbiturates (4), carbon monoxide (5), chloroform, cresol, cyanide, Jeyes' fluid, methyl bromide, nembutal, nicotine (2), petroleum distillate, and strychnine (5).

Two accidental deaths investigated were due to the use of common bottles to contain dangerous substances.

A large number of samples of blood and of urine from victims of traffic accidents, from suicides, and from a person suspected to have been murdered were examined for the presence of alcohol.

Oil, Bitumen, and Tar

The highways work is still largely confined to routine examinations of road tars and bitumens. Samples of petroleum and bituminous products examined included aviation petrol, jet-engine fuel, petrol, lubricating oils and greases, Diesel fuels, kerosene, &c.

Physical Chemistry

The most useful field for spectrography is, in general, in qualitative analysis, but a recent development has made possible semi-quantitative analyses. This has been used for the preliminary examination of alloy steels prior to chemical analysis. It has also been used in examining magnet steels, alloys of aluminium, certain house-construction materials, boiler scales, and lead compounds for ceramic firing ovens.

Phormium tenax (native flax) leaves and roots were examined for trace-element deficiency in connection with yellow-leaf disease. No deficiencies were found.

Much information was supplied to industry by means of circulars and letters, particularly on plating problems.

Metals and Corrosion

About half of the work performed by this section was of direct assistance to New Zealand industries.

Materials of which analyses were made included carbon steels, alloy steels, alloy cast iron, magnet alloys, arc-welding materials, solder-type metals, bearing-metals, brasses, bronzes, aluminium alloys, zinc dross, boiler plate, boiler tubes, and turbine blading.

In corrosion problems the main physical and chemical factors causing the corrosion are determined. From information available or from actual tests remedies are then recommended. These may take the form of improving the environment of the metal, replacing the metal by a more corrosion-resistant material, or using a suitable protective coating.

Problems included the corrosion of domestic electric hot-water systems, welded stainless-steel plate, high-tension transmission condensers, steam-turbine economizer, trawler-engine, tank-periscopes, and grenade components.

Corrosion investigations and pipe-line protection work have resulted in the discovery of two areas in the North Island where the ground waters are highly aggressive. These waters may cause serious deterioration of buried concrete and metal structures, and investigations to prevent this are under way.

Coal Survey

The Coal Survey Laboratory has continued to co-operate with the field staffs of the Geological Survey and the Mines Department in the physical and chemical survey of the coal resources of the Dominion.

Analysis of samples has included the following: coal, mine air, briquettes, coke, shale, and petroleum.

The laboratory apparatus for testing the inflammability of coal-dust recommended by the British Safety in Mines Research Board was set up and tests made to show the minimum amount of limestone-dust required to suppress the inflammability of three coals from the Greymouth district.

Other subjects receiving attention were Waikato peats, Mataura lignite (including a report on a visit to Australia), metallurgical coke, and the use of medium- and high-sulphur gas coals for gas-manufacture.

Chemical Engineering

Much of the work undertaken by this section consists of the translation of work from the Laboratory into the industrial phase.

A project commenced this year was the removal of hydrogen sulphide from coal-gas. The apparatus designed should simplify the purification of coal-gas from high-sulphur coals when applied under commerical conditions.

The work on fuel technology has extended over the whole of New Zealand and visits were paid to fifty-five of the six hundred larger boiler installations. A large volume of information was circularized on all aspects of fuel efficiency. Indications are that the more widespread application of the knowledge available could result in very large savings in coal.

Other projects have been in connection with the following: apple-processing and apple-juice plant at Motueka, modified tobacco-curing kiln, experimental production of antibiotic material such as penicillin, improvement of bentonite, and the operation of a continuous-tunnel kiln for terra-cotta roofing-tiles.

There is a growing demand from industry for the benefits that can be obtained from scientific process control.

General Investigations

Considerable work was carried out in determining the residual amounts of the insecticide D.D.T. left on apples, tomatoes, and cabbages treated by both spraying and dusting. The work indicated that adequate control of the insects was obtained without toxic residues being left.

Building-materials Investigations

(See Building Research report, p. 8.)

DOMINION PHYSICAL LABORATORY

During the year the number of separate items of work handled for industry and other Government Departments has exceeded one hundred per month. The staff has now been established on a permanent basis. Agreement has been reached with Treasury Department on a system of charging-costs for work performed at the Laboratory.

A Nuclear Physics Section has recently been established and will concentrate on instrumentation problems concerned with the application of radio isotopes to biological and medical problems.

A small booklet describing in full the services available to industry from the laboratories will shortly be available.

General Physics

Frost Investigations, Central Otago.—Initial measurements were carried out in the Earnscleugh area, near Alexandra, during the autumn frost period of 1947 of atmospheric temperature, humidity, wind velocities, and direction. On the basis of these results further measurements were carried out during the spring frosts. It has been established that the inversion ceiling of temperature is too high to permit the use of fans for drawing warmer air down from the upper layers to combat the frost.

Tests on Rock from Cobb River Dam-site.—Comprehensive tests of the physical properties of foundation rock from the Cobb River dam-site have been completed.

North Island Ironsands.—The separation by mechanical or simple chemical means of titanium from the iron in the titaniferous magnetite of the North Island west coast ironsands has been investigated by x-ray crystallographic technique. The minerals are so intimately mixed that there is little hope of finding any economic means of separating them mechanically.

Building Research Projects

(See Building Research report, p. 8.)

Instrumentation Laboratory

Clinical Sphygmograph.—Development work is proceeding on an apparatus designed to give a visible and permanent record of changes in blood-pressure in the human subject during the course of surgical procedures under general anæsthesia.

Other Projects.—The following is a selection of the instruments developed or investigated: frost-alarm, photofinish equipment for racing, beehive-temperature recorder, and aircraft-weighing machine.

General Calibration and Testing of Instruments.—This Laboratory has had an increasing volume of work of this category because no substantial diversion of commercial instrument-repair has been possible as yet to private firms. The latter is precluded because of the somewhat specialized equipment and techniques involved.

Standards Laboratory

The following standards are at present being set up: electrical, linear, mass, temperature, photometric measurements and standards, and the barometric standard. The officer in charge of this section returned from overseas, and a start has been made in developing techniques and methods associated with Standards practice. Orders and estimates are being prepared to build up equipment to a level consistent with the Standards legislation, 1945.

Design Section

Major projects handled by this Section included river-stage recorder (for recording river-levels), vehicle-volume counter, portable chronograph, sun camera, fruit-bud apparatus (to test frosting temperatures), ultra-centrifuge, and mechanical high-vacuum pump (for fish-liver-oil distillation).

In addition to the above, a number of smaller projects have been handled and a large amount of routine drawing and tracing work undertaken.

Electrical, Electronics, and Acoustics Laboratory

The work of this Laboratory falls into three main categories: development of electrical and electronic aids to engineering and industry, instrumentation for reserach and survey work, and routine electrical testing.

Aids to Engineering and Industry.—A cross-cut of the work includes construction of grass-seed and flax-fibre moisture meters, sealing of pliofilm bags using radio frequency di-electric heating, and measurement of thickness and location of flaws in metal by supersonics.

Instrumentation for Research and Survey.—Projects include a photo-electric instrument for observing hairiness in wool and measuring mean length of fibres in wool staples, measurement of moisture content of wool, and repair and overhaul of geophysical instruments, &c.

Routine Testing.—Routine tests have been carried out on electrical materials and components, including marble and slate, switches, motors, hearing-aid batteries, indicators, microphones, and audiometer apparatus.

Radio and Radar Laboratory

(*a*) *Radio Research: Frequency Prediction Investigation.*—Radio circuit performance compared with long-term ionosphere predictions revealed that correlation was not good. Short-term predictions from overseas compared with sunspot observations made at Carter Observatory were much superior.

Further investigations have covered short radio paths, solar noise at radio frequencies, and ionosphere and cosmic-ray research.

(*b*) *Radio and Radar Development: Radar in Shipping.*—Routine inspection and maintenance of marine radar has been carried out and a simple radar equipment operating at 500 mc./s. was installed in m.v. "Ranui." A radar set of special value in navigating close waters has been installed in the "Tamahine."

Microwave meteorological radar sets have been completed for Whenuapai and Fiji. The former is giving satisfactory service and the latter is in transit.

(*c*) *Canterbury Project.*—Field observations on the Canterbury Project ceased about mid-December, 1947. Some ninety observations were made in north-west conditions of varying intensity.

It is considered that the data obtained will go far in elucidating the problems involved in the phenomenon of super-refraction, especially on the correlation of abnormal refractive index gradients in the atmosphere with the associated behaviour of U.H.F. radio waves on wave-lengths from 3 metres to 3 cm. Further, enough data has been obtained to determine an adequate forecasting technique for the intensity of super-refraction under advection conditions.

A full analysis of the results is now proceeding. The whole project has been an excellent demonstration of team-work with New Zealand and United Kingdom scientists co-operating.

Engineering Laboratory

Fibration of New Zealand Woods.—A pilot plant is in operation for fibrating New Zealand woods and other materials by the steam explosion process. Southland beech has been the principal timber involved, and pulp produced has been pressed and heated to form wallboard. The results are very encouraging.

Hydraulic Model of Maraetai Dam.—A model of the spillway and diversion tunnel of the Maraetai Dam has been designed and is at present under construction. The object of the model is to study the tunnel flows with a view to determining the capacity of the intake, the erosion effects of the issuing jet, and the meeting of various tunnel flows and river flows at the outlet end.

Other special equipment produced has been for electro-magnetic separator for iron-sands, measurement record of dynamic stresses in bridges under load, and modification of heat treatment of high-speed steels.

Routine Testing.—Much routine testing has been carried out.

Precision Workshops.—The tool-room has handled during the year 823 requests for the manufacture of machine parts, tools, instruments, and repair of instruments involving nearly 4,000 separate items.

ENTOMOLOGY DIVISION

Subterranean or Porina Caterpillars

During dry weather conditions from spring onwards caterpillar populations were greatly reduced, particularly on lighter soils. In the absence of sufficient pasture, the caterpillars will migrate on the surface day or night. Irrigation, although not harming the caterpillars, stimulates the pasture growth and maintains it in spite of attack. As soon as irrigation ceased (or on non-irrigated areas) the pasture was eaten bare. Poisoned wheat germ with chaff and sawdust has proved a good substitute for poisoned bran.

Grass-grub

Soil moisture is the important factor influencing the abundance of grass-grub. There is a low grub population in dry seasons and dry soils. Experiments with insecticides have resulted in a valuable control of the beetles. D.D.T. was used with excellent results. In any extension of this on a wide scale, serious consideration of the influence upon honey and humble bees must be given, especially in honey and clover-seed regions. Attempts are being made to find a reliable means by which farmers can be notified when to expect flights of beetles, upon which depends their sowing of cruciferous crops.

Researches are being carried out by a New Zealand officer in Australia on the natural enemies of the grass-grubs, because none exist in New Zealand. So far one such parasite has been successfully reared on New Zealand grubs, indicating that Australian parasites will attack the New Zealand grass-grubs. It has now been possible to narrow the field of research.

Advisory Work

Advisory work has been undertaken for different Government Departments, public bodies, farmers, and the general public. The field covered agriculture, horticulture, forestry, timber industry, and public health.

Other Activities

The main results of the experiments on the red-legged earth-mite are not yet to hand.

It has been demonstrated that the larvæ of the Australian soldier-fly cause severe stunting of maize. The population is reduced by cultivation.

A survey of the fertilization of red clover indicated the need for humble-bees. It was found impossible to bring in bees from England because of the possibility of disease infection. The possibility of obtaining bees from North America is now being investigated. This project is operated conjointly with Canterbury Agricultural College.

The possibility of the blackberry mite attacking raspberries is being followed closely.

Insects in relation to cocksfoot stem-borer, yellow leaf of phormium, manuka disease, crane-fly larvæ in pastures, and wireworms have been studied.

FATS RESEARCH LABORATORY

Detailed investigations of the composition of butterfat have been continued with increasing success. Techniques developed in the Laboratory are in advance of those used in other parts of the world.

The production of the fish-liver-oil industry (based originally on work done by officers of the Laboratory) has now reached the vicinity of two billion units of vitamin A per annum, derived mainly from sharks. Research on molecular distillation of fish-oils has been maintained and has led to further development of this relatively new industry.

The whaling-station at Tory Channel was visited twice during the last season to obtain oil samples for analysis from the blubber, bone, meat, and liver. An officer of the Laboratory was seconded to the Department of Scientific and Industrial Research, Great Britain, for work on the whaling research vessel in the Antarctic. First-hand knowledge will thus be gained for application in the local industry.

Miscellaneous projects have included studies on the oil extracted from horse and eel flesh, also neat's-foot oil and wheat-germ oil.

GEOLOGICAL SURVEY

Mapping and General

In North Auckland new areas have been mapped. By the discovery of more fossils it has been possible to revise the stratigraphy and show that some districts previously regarded as barren areas below the coal measures are possibly lying over and hiding the coal measures. When the geological structure is known in detail, problems of water-supply will be simplified.

The Pahotai copper has been mined and drilled, but has not been found in a large mass.

Further investigation and mapping has been carried out in a number of districts, including the Wanganui area, "mineral belt" of Nelson, Oamaru, West Southland, and Oraihanga (quartzite and greensand). High-grade glass-sands have been sampled at Parengarenga and Mount Somers.

The coalfields of North Auckland, Reefton, Greymouth, Murchison, South Otago, and Southland have been investigated continuously and the latest information from field-work, drill-holes, and mining has been compiled, tested, mapped, and used to guide further work; but, due to the loss of trained personnel, work cannot be planned ahead. It has to be done in haste to meet immediate needs.

Diatomite has been examined near Taumarunui and Hawera.

Bentonite and pozzalana were sampled in the Wairarapa and the East Coast.

Dams, tunnels, roads, quarry sites, &c., have been reported on for local bodies, Government Departments, &c.

Vulcanological Observatory

Vulcanology and thermal activity are being investigated by collecting data on temperature, composition, acidity, pressure, volume, &c. The area is being mapped in detail.

A report on the "Utilization of Natural Steam and Hot Water at Rotorua" has been prepared.

The Waikato dam-sites are inspected monthly from Rotorua, and special seismic equipment is being operated continuously at the dams.

Water-supplies

One officer has been transferred from field geology and put in charge of this work.

Water-supplies have been reported on at Whangarei, Auckland, Cambridge, Three Kings, Rotorua, Rangitaiki, Wairakei, North and South Canterbury, Timaru, Waikouaiti, and Southland.

Palæontology

Field officers regularly send in collections of fossils for identification. These are used in the correlation of information on various strata and often have a most important bearing on the utilization of economic deposits.

Petrology

Studies are being made on aggregates that react injuriously with cement and tests and examinations of building-stones, concentrates for radio active minerals, glass-sands, and miscellaneous specimens.

Geophysical Survey

Full co-operation was achieved during the year with the State Hydro-electric Department, State Forest Service, Tourist Department, and Mines Department.

The dam-site at Cobb Valley was examined by magnetic, seismic, and electric methods. Two possible dam-sites were suggested and a diversion tunnel route indicated.

Holes were drilled for the State Forest Service at Whakarewa and steam obtained under great pressure at a depth of 200 ft.

GRASSLANDS DIVISION

The work of the Division has continued to expand and is becoming keenly appreciated both in New Zealand and overseas.

Plant Breeding

Work has been concentrated on the improvement of nucleus-stock seeds and, in particular, persistency characteristics of short-rotation rye-grass. Some success has been achieved.

Blind-seed Disease

Work has continued in attempting to combine the resistance to blind-seed disease of some otherwise inferior agronomic types of perennial rye-grass with the desirable agronomic characteristics of pedigree perennial rye-grass. Some progress has been made in selection and breeding resistance to blind-seed disease, but such work must be regarded as a long-term project.

Strain Ecology

There is a continued high demand for strain testing for certification. Sufficient nucleus seed of the more important grass species is being produced annually to supply the stocks for admission into the higher grades of certified seed. The superiority of New Zealand strains against overseas strains of the same species has been amply demonstrated. Extended co-operative trials have been undertaken with the Department of Agriculture.

Pasture Ecology

These trials have demonstrated the following points:—

(*a*) Significance of clover to high grass-production in pasture.

(*b*) Low phosphate response in a low-legume sward.

(*c*) High potential carrying-capacity of good pasture swards under controlled grazing management.

Hill Country Over-seeding Trials

The significance of clover to hill pastures, and particularly those that are being top-dressed, is under trial. Present indications are of a good take and promising results on the wet and more shaded country, but poor results on dry and sunny slopes. Trials are under way in Poverty Bay, lower Hawke's Bay, Wairarapa, Manawatu, King-country, and back Taranaki.

Soil Conservation

Collaborative trials are under way with Poverty Bay, Manawatu, Rangitikei, and Wairarapa Catchment Boards. Additional specialized work has been planned and undertaken at Te Awa and a further 130 acres has been acquired for grazing management trials and run-off records.

Aerodromes

Advice has been given on the maintenance of aerodrome surfaces and some additional research on "turf" production commenced.

Greens Research

There is a widespread demand for advice and servicing. The greens research area has been extended to include habitat studies on "weed" greens. There were two greenkeeper conferences during the year.

INFORMATION BUREAU

Publications.—A very large increase in the amount of material submitted for publication has taken place. Some twenty-five bulletins are now in hand. New publications issued with the assistance of this section have been *Paint Review* and *Agronomy Review*. Arrangements have had to be made for most of the printing of the Department to be undertaken by private firms, and this arrangement has extended to the *N.Z. Journal of Science and Technology* after a period of eight months during which no material was set in type.

Information.—District Information Officers are now operating in Auckland and Dunedin, giving special service to industry. An appointment in Christchurch is pending. This specialist service is supported by the publication of industrial abstracts in the *Industrial Bulletin* (issued with the Department of Industries and Commerce). Major requests for information from all industrial sources have totalled over 400.

Library and Technical Records.—The general development of library and technical record resources reported in 1947 has been continued.

Publicity and Photography.—The Department's activities have been brought before the public through displays (Christchurch Industries Fair), items of news in the daily press, and semi-technical articles in journals such as *N.Z. Engineering*. Photographic services are being provided for branch record and publicity work.

War History.—Narratives on the work of the Department in defence science during the war will be completed shortly and an official war historian appointed. The Department has been allotted one volume in the official war history, entitled "Defence Science."

MAGNETIC OBSERVATORY

Terrestrial Magnetism.—At Amberley the three types of magnetographs were operated continuously and absolute observations were made weekly. Local data of international importance were forwarded regularly to various parts of the world. Magnetic data were supplied to the Marine Department for inclusion in the "New Zealand Nautical Almanac."

Magnetic Survey.—The results of the recent magnetic resurvey of New Zealand and up-to-date magnetic charts should soon be available.

Further studies have been undertaken on auroral displays, cosmic rays (including regular measurement), and climatology.

Three reports have been submitted for consideration of the International Union of Geodesy and Geophysics, which will be meeting in Oslo, Norway, during August, 1948.

NUCLEAR PHYSICS SECTION

Radioactive Mineral Resources.—No further reconnaissance survey work for radioactive minerals was done during the year, sufficient data having been assembled to indicate the supply and distribution of our natural resources, which are of too low a grade to warrant immediate exploitation for these minerals alone. Some further work was done on the heavy mineral concentrates from dredges, and it was shown that at present market values it would not be economic to separate the radioactive minerals.

Equipment.—Some further developmental work was done on new types of beta-ray counters. Technical assistance and equipment were made available for tracer-element studies in biological and agricultural research, and field equipment was also used in geophysical prospecting.

PLANT CHEMISTRY LABORATORY

Pasture Growth Studies.—Collaborative work with the Grasslands Division on the factors which influence pasture-production is continuing. There are two phases of the investigation which are of particular interest to this Laboratory:—

(*a*) *The Effect of Animal Excreta in Soil.*—Quantitatively and qualitatively the manurial effect of the grazing animal on high-production pasture is more important than manure from any other source. A study is being made of the nitrogenous materials in herbivorous urine, their fate in the soil, and their effect on nitrification. It is already indicated that the accepted concept whereby nitrogenous materials are converted by micro-organisms through ammonia to nitrate is an oversimplification.

(*b*) *Growth of Plants under Controlled Environmental Conditions.*—The first stage of this project, which is an attempt to sort out the many factors contributing to the growth of pasture plants alone and in association, is proceeding satisfactorily.

Forage Crops.—Although the branch laboratory at the Agronomy Division is not ready for occupation, some analyses on various forage crops have been carried out.

Apple Dehydration.—Much work has been done on the problem of storage of dehydrated apples, and recommendations have been made as to the level of sulphur dioxide required by different varieties, the keeping-qualities and hence the order of marketing of different varieties, and the grade of cellophane to be used for packaging.

Hormone Weed-killers.—The serious problem of washing spray equipment free of these compounds has been solved, although unsatisfactorily to the commercial user. With all preparations very thorough washing is required, while with oil-based materials special treatments have to be applied.

Antibiotics.—All fabrication work on the pilot-scale equipment has been completed. The unit should be in operation by May, 1948.

Metabolism of Green Leaves.—This long-term investigation, which is complementary to the studies on pasture growth, has been vigorously prosecuted during the year. It has been established that the anomalous results reported in last year's report are due to urea and urea compounds, which are of particular importance during periods of active growth.

PLANT DISEASES DIVISION

Plant Diseases Investigation

Investigations of specific diseases of tree-tomato, peas, tomatoes, cucumber, and swedes have been continued. Tree-tomato is subject to three virus diseases, of which one is known to be cucumber-mosaic.

Investigations to elucidate specific problems in relation to the following diseases have been carried out: tree-tomato mosaic, pea-mosaic, tomato spotted-wilt, cucumber-mosaic, swede soft-rot and dry-rot, blind-seed disease of rye-grass (factors influencing infection), raspberry verticillum-wilt, light leaf-spot of brassicas, curcubit-wilt (troublesome on watermelon and pumpkin in Auckland area), chocolate-spot of broad beans, celery-stem crack (corrected by borax application), hollow stem of brassicas, yellow-leaf of phormium, linen-rust (linseed and linen-flax rust).

Therapeutant Testing and Improvements in Disease Control

(See also Fruit Research Report, p. 11)

Blind-seed Disease of Rye-grass.—Trials showed that the best control was secured with sprays of Bordeaux. Next in order of decreasing effectiveness were Dithane, Phygon dust, Phygon solution, and Fixtan.

Grape Mealy-bug.—Control in the glasshouse was secured with a dust containing 5 per cent. p.p.i. D.D.T. and a spray containing 1 per cent. D.D.T.

Tomato Late-blight (Field Tests).—Phygon gave adequate control but caused excessive plant injury; Dithane, moderate control and damage; while Cuprox and Coppesan gave adequate control without plant injury.

Tomato Leaf-mould (Comparative Glasshouse Tests).—Phygon gave good control but caused serious plant injury at 1–4000. Shirlan AG gave moderate control, whereas T.M.T.D. and Fermate were less effective.

Certification of Therapeutants.—Forty-four products were certified during the year.

Pomology Investigations

(See Fruit Research Report, p. 11)

Timber Preservation Investigations

(See Building Research Report, p. 8.)

Miscellaneous

Synthetic Hormone Injury.—Severe injury to a wide range of economic plants has been demonstrated by traces of 2–4 D (a hormone used as a weedkiller). This may result from spray drift, vapour, or residues left in spray pump.

D.D.T. in Paints.—A flat oil paint with D.D.T. is the most effectual in destruction of flies, next in decreasing order of effectiveness enamel, oil-bound water paint, and distempers.

Disease-free Tomato-seed.—Thirty-five pounds of tomato-seed of the variety Potentate has been produced ready for distribution to growers for next season. Acid extraction of seed has been investigated and a technique evolved suitable for New Zealand. It is simple, efficient, cheap, and yields a superior sample of seed. Tree-tomato, cucumber, and passion-fruit seed can also be produced by this method.

Legume Culture.—Cultures for 190,000 lb. of lucerne-seed has been supplied to 1,610 farmers. Figures show a decrease of 23,000 lb. (approximately 1,300 acres) from the previous season.

SOIL BUREAU

Erosion Surveys

An erosion survey of the northern half of the North Island was completed. The maps of the southern half are published and the text is in the press. Salient points of the northern survey are —

(1) A large proportion (56 per cent.) of the land shows little evidence of erosion under present farming methods.

(2) There is less slip and more sheet erosion than in the southern half.

Soil Surveys

(*a*) *General Surveys.*—Only two maps of the North Island survey remain unpublished. These are now being printed. Further work has been undertaken in the South Island.

(*b*) *Provisional Surveys.*—A report on the soils and agriculture of Westland is in the press. Soil maps of Southland and parts of Marlborough are complete.

(*c*) *District Surveys.*—The following is the progress: *North Auckland*, practically finalized; *Hutt and Makara Counties*, soil map finalized; *Wairarapa Plains*, the plains west of Ruamahunga River are mapped, maps of the lower Wairarapa Valley were used to assist Lands and Survey and Agriculture Departments with drainage investigations; *plains and downlands of Canterbury*, soil map complete; *Green Island – Kaitangata district*, soil map prepared.

(*d*) *Detailed Surveys.*—*Whangarei County*, soil maps completed, report in preparation; *Taupo*, soil survey commenced; *Maniototo Plains*, soil survey made to assist Ministry of Works with irrigation plans.

Soil Chemistry

As in previous years, the bulk of the chemical work done in the Laboratory has been for soil surveys in progress.

Soil Phosphates.—The first experiments in New Zealand were made with the aid of the Nuclear Physics Section on the use of radioactive phosphate as a tracer in the utilization of phosphate by the plant. Radioactive material was processed in the Dominion Laboratory and supplied in the form of superphosphate. Results indicated that 70 per cent. to 80 per cent. of the phosphate taken up by the plants came from the fertilizer added. Work of this nature will be of inestimable value in New Zealand agriculture.

Soil Corrosion.—A number of service jobs on pipe-lines have been undertaken.

Biochemistry.—A number of soil deficiencies have been investigated.

Soil Physics

The requests from civil engineers for soil-testing services have continued to be numerous and the soil-mechanics work has again formed the major part of the year's activities.

Building-foundation Surveys and Earth Dams.—Sites for proposed hospital buildings in Christchurch, Rotorua, and Thames, and oil-storage-tank sites in the four main ports, have been examined. Tests have been carried out on soils being used for earth dams at Pukaki and Roxborough. Building-settlement investigations have been continued.

Agricultural Physics.—Work is continuing on the soil structure of cropping-lands that show signs of deterioration.

Soil Biotics

Soil Ecology.—An account of the influence exerted by various native plants on soil-formation in Fiordland and Southland has been prepared for publication.

Biological Assay.—A technique for using plants to detect the minimum level of available boron in pot experiments with a range of soils is not yet completed. Beans, radish, and beet have proved valuable indicator plants.

Trace-element trials have been continued on soils that are known to be difficult to farm.

Fertility trials in which commercial compost is being compared with other nitrogenous manures and mineral fertilizers are in progress.

The *Aspergillus* method for evaluating available copper in soil has proved quite satisfactory for comparing the available copper status of New Zealand soils. The available copper in the sand and silt loam of the farm lands of North Auckland is very low. Further surveys are being made.

WILD-LIFE RESEARCH

The survey of the wild-life position in New Zealand was completed at the end of 1947 in the form of an "Interim Report on Wild-life Problems in New Zealand." The three volumes of this cyclostyled report cover sixteen of the economically most important introduced mammals. It was submitted to a conference of representatives of Government Departments and public bodies interested in wild life held on 3rd February, 1947. This conference unanimously advised the Council of Scientific and Industrial Research "that sufficient research is not being done at the present time on wild-life problems." It also recommended the establishment of a Wild-life Advisory Committee of the Council which would make recommendations with regard to problems of research and its organization.

A supplementary survey is being undertaken of nine species not included in the interim report. It is hoped to publish the completed survey as a bulletin during the coming year.

COMMONWEALTH AGRICULTURAL BUREAUX

The Imperial Agricultural Bureaux, which were established by the participating Governments of the British Empire as a result of the 1927 Imperial Agricultural Research Conference in London, have recently been redesignated the Commonwealth Agricultural Bureaux.

New Zealand is represented on the Executive Council of the Bureaux by Dr. E. Marsden, Scientific Adviser, London. The funds of the Bureaux are provided by the participating Governments in agreed proportions.

The Bureaux are continuing to render a most valuable service to New Zealand agricultural research workers, principally through their abstracting journals and technical communications.

SCIENTIFIC LIAISON SERVICES

During the year the Department's scientific liaison services have been reorganized and strengthened. Dr. E. Marsden, formerly Secretary of the Department in Wellington, was appointed by the Government to the position of Scientific Adviser, London, and the Scientific Liaison Office in London was placed under his control. Approval has since been obtained to the appointment of an Assistant Scientific Liaison Officer in London, and an officer will leave to take up the appointment at an early date.

Approval was also given to New Zealand's participation in the British Commonwealth of Nations Scientific Offices, London. This organization is somewhat similar to that in which we are already participating in Washington and which was found to be so extremely valuable during the war period. In both London and Washington the New Zealand Scientific Liaison Office is accommodated alongside the Scientific Liaison Offices of the other dominions and the United Kingdom. The Scientific Liaison Officers, although independent and directly responsible to their own Governments, co-operate to the fullest extent.

SCIENTIFIC MAN-POWER COMMITTEE

This Committee was set up in February, 1947, by the Honourable Minister for Scientific and Industrial Research with the following order of reference :—

> " To consider the policy which should govern the use and development of our scientific man-power and resources during the next ten years and to submit a programme on broad lines so as to facilitate foreward planning in those fields which are dependent on the use of scientific man-power."

During the year a considerable amount of material relevant to an adequate appraisal of the scientific man-power position has been collected by statistical analysis, questionnaires, and personal submissions requested by the Committee from scientists.

A brief questionnaire sought to clarify the definition of " qualified scientist " which would be most applicable to the survey. Two reports to the Committee have been prepared by the Research Division of the Department of Labour and Employment.

These two reports cover in detail the " University Training of Scientists " and " The Employment of Scientists in New Zealand." The former shows numbers of graduates and numbers specializing in the various scientific subjects over the last twenty years. The second report, based on a questionnaire circulated within industry and Government Departments, covers the present employment position and anticipated future requirements.

These reports are basic data which will be drawn upon by the Committee, together with other material yet to be collected, in formulating its final report and recommendations.

The Committee is giving attention also to the general question of training and emolument of scientists and other problems related to the future healthy development of scientific work in New Zealand.

Approximate Cost of Paper.—Preparation, not given; printing (683 copies), £75.

By Authority: E. V. PAUL, Government Printer, Wellington.—1948.

Price 1s.]